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Canadian Science Advisory Secretariat
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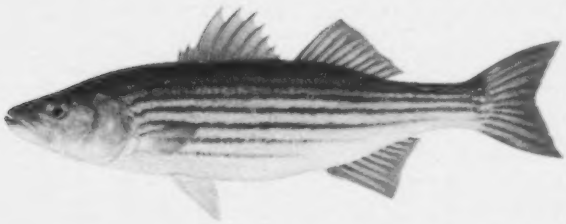
INFORMATION IN SUPPORT OF CRITICAL HABITAT IDENTIFICATION FOR STRIPED BASS (*MORONE SAXATILIS*) OF THE ST. LAWRENCE RIVER



Source: Fédération québécoise des chasseurs et pêcheurs

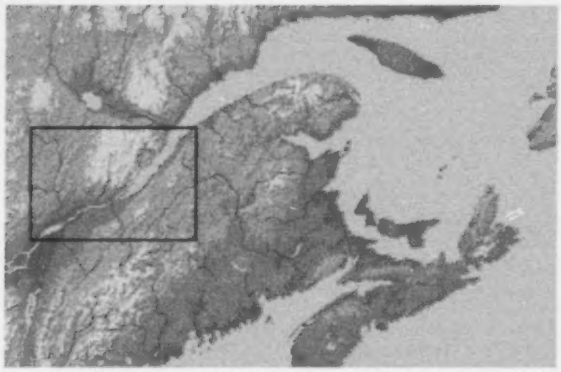


Figure 1. Historical range of the striped bass population of the St. Lawrence River. Taken from Robitaille 2010.

Context:

The striped bass (Morone saxatilis, Walbaum 1972) population of the St. Lawrence Estuary (Figure 1) was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2004 and designated as an extirpated species. The population has been listed on the Species at Risk Act (SARA) since 2011. Following reintroduction efforts by the Ministère des Forêts, de la Faune et des Parcs (MFFP) du Québec that began in 2002 to establish a new population capable of self-reproducing and maintaining itself, the striped bass population has seen both an increase in abundance of its population and distribution and confirmation of natural reproduction. In 2011, the status of the striped bass was reassessed by COSEWIC. This population was renamed the St. Lawrence River population and was designated as endangered (COSEWIC 2012).

Under the SARA, the critical habitat must be designated for any threatened, endangered or extirpated species. A first Science Advisory Report on the assessment of the habitat quality and its use by the striped bass population of the St. Lawrence Estuary was produced in 2011 (DFO 2011). A portion of the critical habitat of the St. Lawrence striped bass is currently defined in the recovery strategy. The DFO's Species at Risk Management Program submitted a request to the regional Science Branch of Quebec for a Science Advisory Report to continue efforts to determine the critical habitats for the recovery of the St. Lawrence striped bass and eventually, complete the designation of critical habitat. This Science Advisory Report is from the March 15, 2016, meeting on the assessment of the habitat necessary for the survival and recovery of the striped bass of the St. Lawrence Estuary.

SUMMARY

- Since 2010, a series of scientific fisheries and a network of acoustic receivers strategically placed in the St. Lawrence River and its main tributaries have helped to monitor the movements of striped bass fitted with acoustic transmitters and thereby to identify the main

areas of adult concentration. In 2013, the implementation of a standardized survey program resulted in an annual recruitment index that monitors reproductive success.

- The range of the St. Lawrence River striped bass population was defined as the area frequented by at least 10 percent of the tagged striped bass. Based on this criterion, the range extends from upstream of Gentilly to Rivière-Ouelle on the south shore, and upstream of the Saguenay, on the north shore. The delineation of the range downstream, on the north shore, is currently inaccurate because no receivers have been installed beyond the Saguenay River. However, the total range extends beyond these boundaries, with an area of overlap with the neighbouring population of the southern Gulf of St. Lawrence.
- The seasons play a major role in the spatial and temporal distribution of striped bass. Striped bass congregate in limited areas in the winter and disperse to cover large areas in the spring and summer. The arrival of fall initiates a movement to return to wintering sites.
- In winter, adult striped bass are heavily concentrated south of Isle-aux-Grues, near Québec City. The movements of striped bass were also observed between these two wintering areas, which suggests that the Chenal des Grands Voiliers linking these two areas is minimally used as a winter travel route.
- During the open water period, an area of special importance for adult striped bass was observed along the north shore of the upper estuary, at Isle-aux-Coudres. Another important area was identified on the south shore of the St. Lawrence, starting upstream of Québec City, continuing along the Chenal des Grands Voiliers south of Île d'Orléans, encompassing the area surrounding Isle-aux-Grues, and ending just downstream of Rivière-Ouelle. Within this area of concentration, three sites are distinguished by an especially significant presence of striped bass during the period suitable for reproduction: Beauport Bay, the mouth of the Rivière du Sud and the Rivière Ouelle. Unlike the first two sites, the presence of striped bass in Rivière Ouelle remains high throughout the open water period.
- A first spawning ground was identified at the mouth of Rivière du Sud at Montmagny in 2011. The observations made at the Québec port area strongly suggest that this is also a spawning area for the striped bass population in the St. Lawrence River.
- Rivière Ouelle seems to play an important role during the reproduction period. Significant concentrations of individuals have been observed before, during, and after the reproduction period, especially of adult females. However, additional work is needed to identify the role of this river.
- An intertidal area of 0-5 metres with habitat potential for the larvae and young-of-the-year was delineated. This area lies between Lévis and Rivière-du-Loup on the south shore, and between Neuville and Petite-Rivière-Saint-François on the north shore, and includes the islands in these areas. However, additional studies are required to better define the areas of particular importance for these early stages.
- Even so, the results confirm the importance of Anse Sainte-Anne as a habitat for young striped bass in the fall.
- Since information on the habitat of sub-adults (individuals one to three years of age) is still missing, additional work is required to identify the critical habitats for this stage of life.

BACKGROUND

The striped bass (*Morone saxatilis*) is an anadromous species typically found in the estuaries and along the shore of the east coast of North America. Historically, there have been three distinct populations of striped bass in Canada: those in the Bay of Fundy, the southern Gulf and the St. Lawrence River. Unfortunately, due to habitat alteration, heavy commercial and recreational fishing, and non-compliance with regulations, the St. Lawrence River population disappeared in the late 1960s. Following a commitment to restore the biodiversity of the St. Lawrence, an assessment of the feasibility of re-establishing a population of striped bass was performed. The working committee for the reintroduction of striped bass judged it possible. An action plan was therefore established and the Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP), in collaboration with its partners, launched the first efforts towards recovering the striped bass in the St. Lawrence Estuary in 2002.

Between 2002 and 2015, more than 19,600 juvenile and adult striped bass and 34.5 million larvae were stocked in the St. Lawrence River. In 2003, a monitoring network on incidental catches of striped bass was implemented to assess the parameter of this "new population," to document the survival and establishment of the species, to locate their movements and to identify the spawning and rearing habitats. In 2008, a first overview of the status of this new population was drafted and revealed that adult striped bass were naturally reproducing in the estuary. The first spawning ground was identified at the mouth of Rivière du Sud at Montmagny in 2011.

As part of the Recovery Strategy for the Striped Bass (*Morone saxatilis*), St. Lawrence Estuary population, a portion of the critical habitat was identified based on the information available at the time. This information helped to designate the intertidal area at a depth of 0 to 5 metres of the Anse Sainte-Anne in the St. Lawrence Estuary as essential for juvenile growth. However, the information available at the time was insufficient to identify other types of critical habitats for this population, in particular the specific location of spawning, incubation and larval stage areas, as well as the biophysical components of the habitat that supports these functions. Priority actions to be completed over the next 10 years were identified to re-establish this population and complete the identification of critical habitat.

ANALYSIS

According to the *Species at Risk Act*, critical habitat is defined as the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species. It can involve reproduction, nursery, rearing and feeding areas, migratory routes or areas where the species has already been found. The fundamental assumptions underlying the designation of critical habitats are the existence of a positive relationship between the habitat and the size of the population and the need for a minimum habitat to achieve the recovery goal and the resulting population and distribution objectives.

There is currently no quantitative recovery target for the St. Lawrence River striped bass population. However, the Recovery Potential Assessment conducted in 2005 (DFO 2006) defined a qualitative target: a self-perpetuating population with areas of occupancy and occurrence similar to those of the extirpated population. Work currently underway will be used to define a quantitative target soon.

Analysis of the new information available in support of the identification of the critical habitat for striped bass of the St. Lawrence River has helped to identify important habitats for several functions (reproducing, rearing juveniles, feeding and migration, wintering).

Data available for the identification of important habitats

Range and movement of adults

Since 2011, a vast, fixed-station, passive hydroacoustic telemetry network has been used to continuously monitor adult striped bass fitted with hydroacoustic transmitters in the St. Lawrence system and its main tributaries and thereby determine the range. Between 2010 and 2015, a total of 193 striped bass measuring more than 450 mm were caught in various areas of the St. Lawrence River between Gentilly and Rivière-Ouelle and in the Saguenay River, and were fitted with transmitters to monitor their movements. In 2014 and 2015, the receiver network was extended up to Gaspésie to reach a second receiver network deployed to monitor the movements of the southern Gulf striped bass population. This helped to identify an area of overlapping ranges of the St. Lawrence River and southern Gulf of St. Lawrence populations. This area is located on the north shore of the Gaspé Peninsula.

To identify areas of concentration that are used by mature individuals during the reproduction period, 14 sites located in the river mouths or areas of the river between Rivière-du-Loup and Bécancour were net sampled between 2010 and 2015. The sampled sites were selected because they had been identified as suitable for the reproduction of striped bass based on abiotic conditions or because concentrations of mature individuals had been reported there by recreational or commercial fishers in the spring.

Range and monitoring young-of-the-year

A campaign of intensive sampling by beach seine conducted by the MFFP in the summer of 2012 led to the implementation of an annual recruitment monitoring program of striped bass in the St. Lawrence River. Thus, since 2013, the recruitment monitoring program has included 100 stations located on the south shore between Bécancour and Isle-Verte, and on the north shore, between Trois-Rivières and La Malbaie, including the main islands between these areas. The sampling is conducted annually in September and facilitates the collection of data on the presence and abundance of young-of-the-year striped bass and on environmental variables.

A second monitoring network has identified incidental catches to 21 eel traps (fall eel fishery), distributed mainly between Rivière-Ouelle and Kamouraska, since 2010. This network also helps to document the presence of young-of-the-year striped bass in this area.

Range and movements of adults during the open water period

The seasons play a major role in the spatial and temporal distribution of striped bass. In fact, the general range of the striped bass expands and contracts with the changing of the seasons. While striped bass congregate in limited areas in the winter, they disperse to cover large areas in the spring and summer. The arrival of fall initiates a movement to return to wintering sites. Thus, the distribution and movements of these individuals shows a large contrast between seasons.

General spatial and temporal distribution

Spring is a dispersal period in the upper estuary itself, and also upstream in the river estuary and river section. This dispersal period, which is especially evident in May, partially coincides with the reproduction period. Starting in June, individuals head downstream. Some do not go

beyond the upper estuary, but others move up to the lower estuary and the Saguenay River. These areas would mainly be used for feeding.

In the summer, individuals tend to continue moving downstream or remain in the river estuary, probably to feed. These movements are observed most especially in July. In August, the distribution of individuals is relatively stable.

In the fall, striped bass leave summering areas to gather in wintering sites. They start returning from the downstream areas, such as the lower estuary and the Saguenay River, in September to the upper and river estuaries. In October, individuals are particularly concentrated in the upper estuary and downstream of the river estuary in the Québec City area.

Range and concentration areas

The range of the striped bass population in the St. Lawrence River was defined as the area frequented by at least 10 percent of the tagged striped bass. Based on this criterion, the range extends from upstream of Gentilly to Rivière-Ouelle on the south shore, and upstream of the Saguenay on the north shore. However, it should be noted that striped bass have also been observed upstream in the St. Lawrence as far as the Îsles de Verchères, and downstream on the south shore of the St. Lawrence, well beyond Rimouski. The delineation of the range downstream, on the north shore of the St. Lawrence, is currently inaccurate because no receivers have been installed beyond the Saguenay River over the years.

The threshold of 50 percent was chosen to delineate the areas that are most frequented by striped bass. This criterion is used to consolidate the stations where at least 50 percent of individuals have been observed. Thus, an area of special importance was observed along the north shore of the upper estuary, at Isle-aux-Coudres (Figure 2): Another area of importance was identified on the south side of the St. Lawrence. This area begins upstream of Québec City, follows the Chenal des Grands Voiliers south of Île d'Orléans, encompasses the area surrounding Isle-aux-Grues, and ends just downstream of Rivière-Ouelle (Figure 2). Within this area of concentration, three sites are distinguished by a very significant presence of striped bass during the period suitable for reproduction: Beauport Bay, the mouth of Rivière du Sud near Montmagny, and Rivière Ouelle. Unlike at the first two sites, the Rivière Ouelle site maintains a high population throughout the open water period.

Mobility and migration contingents

Analysis of individual routes in the St. Lawrence system reveals that striped bass can travel dozens of kilometres in a single day. In fact, during the open water period, 50 percent of individuals travel more than 140 linear km.

The maximum extent of the territory occupied by striped bass in the St. Lawrence River indicates a bimodal distribution. This suggests that the St. Lawrence River population may consist of at least two groups using the territory differently, i.e. one group with more limited movements and another with more extensive movements. To date, no analysis has been conducted on the striped bass population of the St. Lawrence River that would formally identify migration contingents. Nevertheless, viewing the routes of each individual in the St. Lawrence system and the usage distribution over the extent of the territory suggests the presence of at least two contingents: a resident contingent and a migratory contingent. The resident contingent is thought to congregate in the upper estuary year round where they would conduct all their activities. The migratory contingent is much more difficult to define because there is considerable variability in the migration patterns. Some individuals only migrate upstream in the spring and then return to the upper estuary where they remain until the following spring. Other migratory individuals are present in the upper estuary in winter and spring, after which they

head to areas downstream in the summer, such as the Saguenay River and Rivière Ouelle. In all likelihood, these areas are used for feeding. Despite the apparent presence of distinct migratory contingents in the striped bass population of the St. Lawrence River, rigorous analyses of the contingents will need to be conducted to identify them properly.

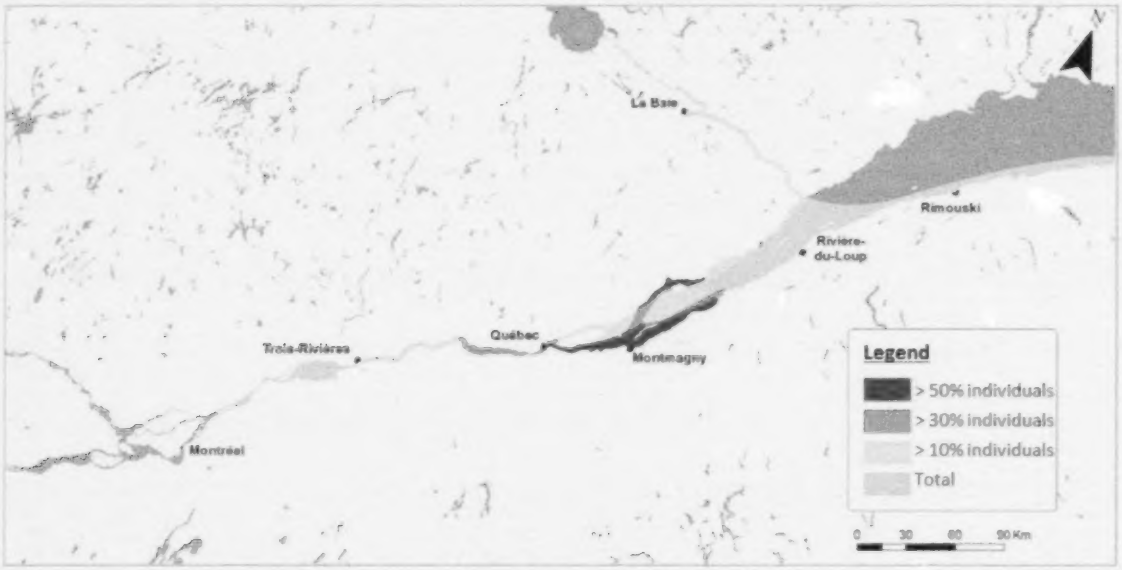


Figure 2. Range of adult striped bass in the St. Lawrence and its main tributaries, and general concentration areas of individuals based on various percentages of striped bass that have been detected.

Adult wintering areas

Movements and wintering areas

As winter approaches, adult striped bass of the St. Lawrence River population become highly concentrated south of Isle-aux-Grues and near Québec City in an area located between Beauport Bay, the western tip of Île d'Orléans and the city of Lévis, hereinafter called the Québec area.

South of Isle-aux-Grues, the number of striped bass observed is especially high in November and December, gradually decreasing until April, when individuals probably start to disperse in the St. Lawrence. Although the number of striped bass observed in this area decreases during the winter, there is a continuous presence of individuals throughout the winter period.

The number of striped bass observed in the Québec area is lower than in the Isle-aux-Grues area; however, the number of individuals observed is stable over time and there is a continuous presence during the winter. It appears, therefore, that the Québec area is also a wintering area.

Throughout the winter of 2014-2015, the movements of striped bass were also observed between these two wintering areas, which suggests that the Chenal des Grands Voiliers linking these two areas is minimally used as a winter travel route. It is interesting to note that no striped bass have been detected upstream of Québec City during the winter. In the upper estuary, all detections have been recorded south of Isle-aux-Grues, and no detection has been recorded downstream of Isle-aux-Grues. All the information obtained on winter movements led to the delineation of wintering areas and of a movement corridor for the wintering period (Figure 3).

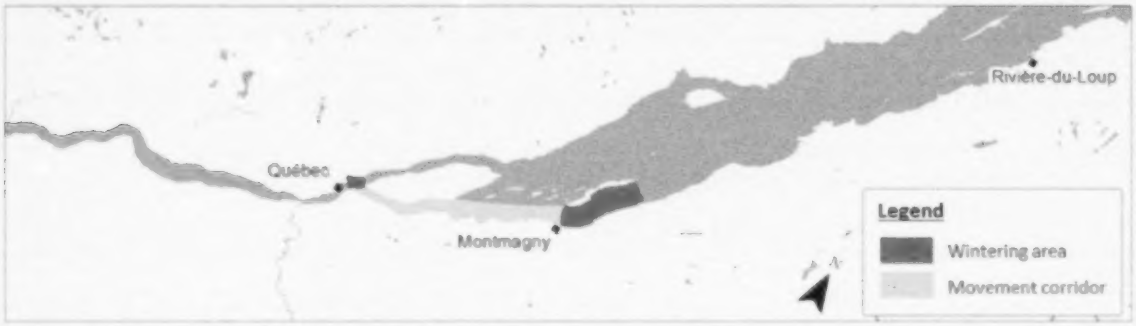


Figure 3. Delineation of wintering areas identified in 2014-2015 and the movement corridor located between these two areas.

Intensive-use areas during the reproduction period

Between 2011 and 2015, 1,389 hours of sampling were conducted during 89 trips between April 30 and June 30, and were spread out among 14 sampling sites. The majority of the monitoring was conducted by catching striped bass using gillnets from mid-May to mid-June. The highest numbers of individuals were caught in Québec port area, at the mouth of Rivière du Sud and in Rivière Ouelle. However, the number of individuals caught per unit of effort is greater at Rivière Ouelle, Rivière du Loup, and in the Québec port area.

Québec port area

With the exception of an individual that was caught in the Saint-Charles River estuary and a few individuals that were caught at the north end of the Beauport Bay beach, all catches of striped bass in the Québec port area were carried out at the extreme port end (Figure 4). Although the sampling effort deployed in this area was greater than at the mouth of the Saint-Charles River and Beauport Bay, the number of striped bass caught per unit of effort was also higher in this area, suggesting that the bass are concentrated there.

Rivière du Sud

Catches of striped bass in the Rivière du Sud basin between 2011 and 2015 were mainly carried out at stations located around the discharge of the Rivière du Sud and the downstream end of channels. It was also at these same locations that the number of catches per unit of effort was highest (Figure 5). These results suggest that striped bass use the channels to enter the basin during high tide and that they are concentrated in the area located at the base of the dam through which Rivière du Sud flows. The Rivière du Sud basin is exposed or has a low water level at low tide. Few catches are made there in the first few hours after the tide begins to rise. This area therefore seems to be primarily frequented by striped bass during high tides.

Rivière Ouelle

In addition to the fixed-station telemetry monitoring of the St. Lawrence River and its main tributaries, telemetry monitoring using a mobile device was conducted in Rivière Ouelle in 2013. This monitoring was conducted at 26 different stations of the downstream portion of the river up to a distance of 13 km upstream from the mouth. The presence of striped bass was recorded from the mouth to a distance of 11 km upstream. An area with a greater abundance of striped bass was identified between 4.5 and 5.5 km from the mouth (Figure 6).

Figure 4. Catches per unit of effort made in the Québec port area between 2013 and 2015. The filled-in circles (in green) represent the stations where the striped bass were caught, while the empty circles represent stations where no striped bass were caught.

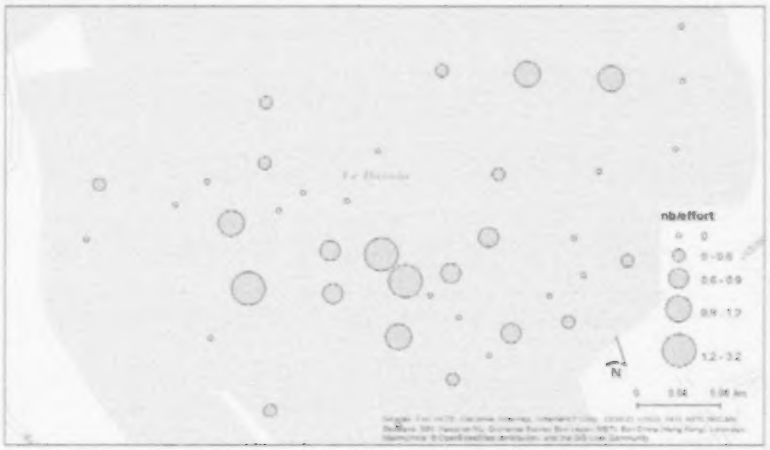


Figure 5. Catches per unit of effort made in the South River basin between 2011 and 2015. The filled-in circles (in green) represent the stations where the striped bass were caught, while the empty circles represent the stations where no catch of striped bass was done.

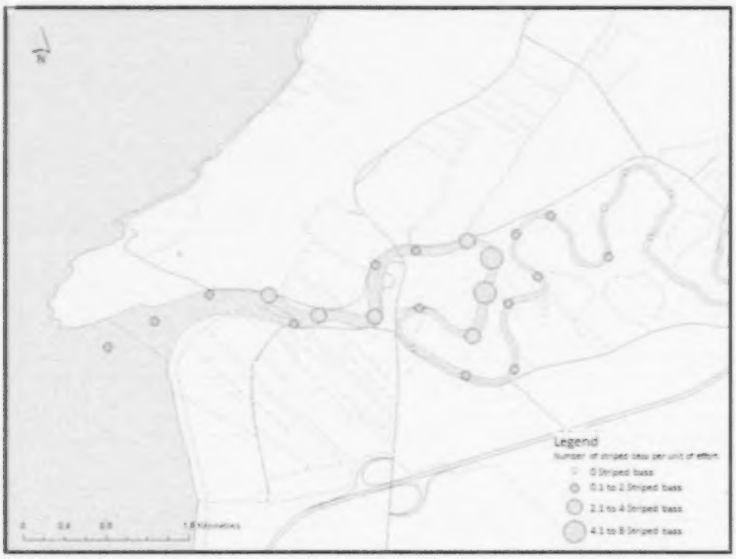


Figure 6. Number of striped bass detected per unit of effort in 2013 in Rivière Ouelle at the mobile telemetry stations.

Monitoring the presence of adults in the identified concentration areas

The analysis of the number of individuals caught by gillnet in Rivière du Sud in 2011 and 2014, in the Québec port area in 2014 and 2015, and in Rivière Ouelle in 2014 indicates that the number of catches in the spring increases with the water temperature and then decreases when it exceeds 18°C, which is the threshold temperature corresponding to the end of the spawning period, in Rivière du Sud and the Québec port area. Few or no specimens were caught in these two areas once this threshold temperature was exceeded, unlike the Rivière Ouelle site, where the number of catches remained high. The proportion of individuals for which the milt can be extracted in Rivière du Sud and the Québec port area is greater when the water temperature is between 13 and 18°C. Taking into account only individuals that have been caught by gillnet during the period suitable for reproduction, the proportion of males that were identified by abdominal compression is much lower in Rivière Ouelle than in the Rivière du Sud basin and the Québec port area.

Analysis of the telemetry data indicates that during the period in which the water temperature is suitable for reproduction, males spend more time in the concentration areas of Rivière du Sud and the Québec port area than the females. However, during the same period, no identified male specimens were detected by telemetry at the mouth of Rivière Ouelle.

During the reproduction period, individuals frequenting Rivière du Sud and the Québec port area appear faithful to the area they frequent. In fact, only the individuals detected in either of these areas were not detected in another area suitable for spawning during this period. However, half of the individuals detected in Rivière Ouelle during the reproduction period were also detected at the mouth of Rivière du Sud or the Québec port area during the same period. In addition, all the fish detected in Rivière Ouelle during the spawning period were also detected there in the following weeks or months. By contrast, no detection was recorded in the weeks or months following the end of the spawning period in Rivière du Sud and the Québec port area.

Identification of reproduction areas

The presence of a striped bass spawning area at the mouth of Rivière du Sud was confirmed in 2011 (Côté 2012). All observations carried out in the Québec port area in recent years strongly suggest that it is also an area used by striped bass for reproduction. In fact, there are predictable gatherings of adult individuals during the spawning period, especially at temperatures suitable for reproduction, i.e. between 13 and 18°C (MFFP, unpublished data). In addition, the proportion of sexually mature males and females in the Québec port area increases when the water temperature reaches levels that are suitable for reproduction, which is also used as an indicator of the presence of spawning sites in other populations of striped bass (Hocutt et al. 1990). It was also noted that when the water temperature is optimal for spawning, the sex ratio in the Québec port area becomes unbalanced in favour of males, which was also observed in other known striped bass spawning areas (Edwards 1969), as well as in the Rivière du Sud spawning area (MFFP, unpublished data). This phenomenon could be explained by the longer residence time of males at spawning sites compared to females (Hocutt et al. 1990; Carmichael et al. 1998; Douglas et al. 2009). Once the spawning period is over, i.e. when the temperature exceeds 18°C, the Québec port area is quickly abandoned by adult striped bass. The abandonment of the reproduction area by a significant number of adults was also documented at other striped bass spawning sites (Setzler-Hamilton et al. 1981; Rulifson et al. 1993; Van Den Avyle and Maynard 1994; Rulifson and Dadswe 1995; Robichaud-LeBlanc et al. 1996; Rulifson and Tull 1999; Douglas et al. 2009). Other observations on the presence of young-of-the-year in the immediate Québec port area and a high concentration of striped bass larvae and young-of-the-year downstream of this area, particularly in the channel of Île d'Orléans, support the presence of a spawning area in the Québec port area. The distribution of larvae and young-of-the-year near spawning sites downstream, but also occasionally upstream, was also observed for the striped bass population of the southern Gulf of St. Lawrence (Robichaud-Leblanc et al. 1996, 1998) and of Rivière du Sud (Côté 2012). Finally, several studies have documented the presence of wintering areas near striped bass reproduction sites (Clark 1968; Young and Isely 2002; Douglas et al. 2009), which is the case for the Québec port area and the Rivière du Sud reproduction site (Figure 3). It is likely advantageous for striped bass to migrate near spawning sites in the fall while their energy reserves are at their maximum, rather than in the spring while they are at their lowest (Douglas et al. 2009). This hypothesis has yet to be confirmed. All of the observations made at the Québec port area therefore strongly suggest that it is a spawning area for the St. Lawrence River striped bass population.

Range of juveniles (age 0+)

Incidental catch monitoring network

Between 2010 and 2015, the monitoring results of incidental catches of 21 eel traps between Rivière-Ouelle and Kamouraska indicate that the majority (32,400 total) of the young-of-the-year striped bass caught, between 81 percent and 95 percent depending on the year, were caught in one of two eel traps located at the eastern tip of Anse Sainte-Anne, near Rivière Ouelle (Figures 7 and 8). Although there is no information to document the use of the area located in the western portion of Anse Sainte-Anne, all evidence suggests that Anse Sainte-Anne is a preferred area for young striped bass during the fall. In fact, before 2010, eel traps directly located in this cove harvested more young striped bass than the fishing gear located at the eastern tip of Anse Sainte-Anne.

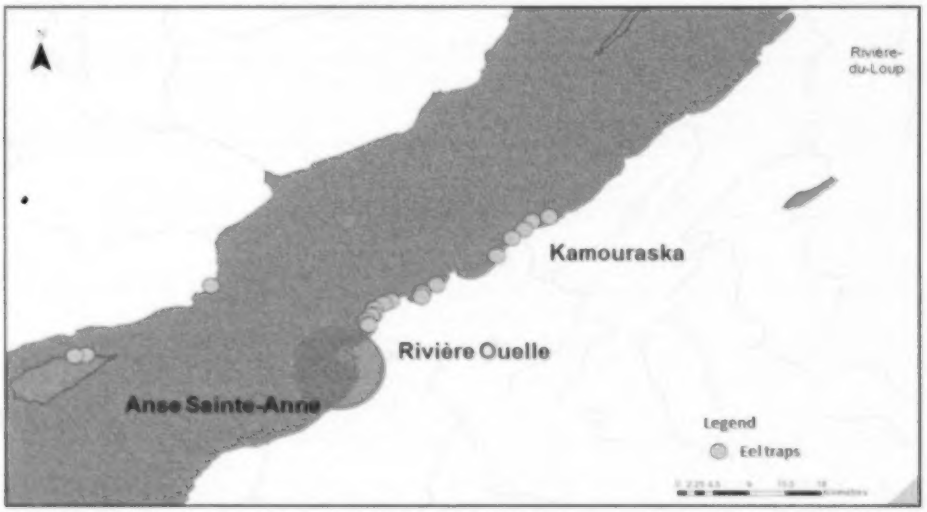


Figure 7. Location of the main reports of striped bass of the year, reported by the incidental catch monitoring network from 2010 to 2015.

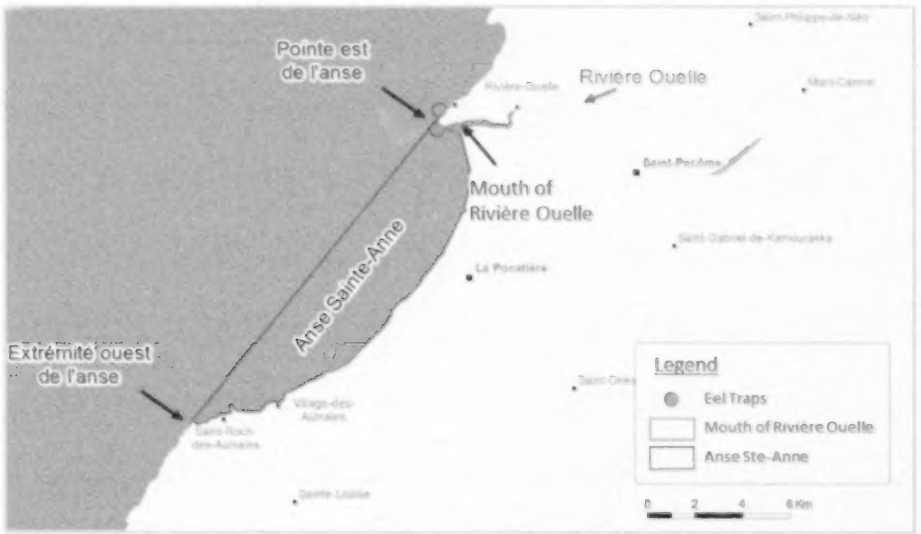


Figure 8. Geography of Anse Sainte-Anne and location of the two eel traps located at the east end.

Annual monitoring of recruitment and characterization of habitats

The majority of young-of-the-year catches from the annual recruitment monitoring network were conducted downstream of Québec City, with high concentrations around Île d'Orléans and in the Montmagny and Rivière-Ouelle areas (Figure 9). The south shore of the St. Lawrence downstream of Île d'Orléans is substantially colonized by young-of-the-year striped bass.

Analysis of the parameters relating to habitat (sunlight condition, surface temperature, surface salinity, surface conductivity, water depth, grain size, dominant and sub-dominant plant species and companion fish) collected in August and September 2012 does not reveal any particular

type of habitat sought by striped bass of the year. Unlike the egg and larval stages, which are more fragile, the young-of-the-year tolerate variations in environmental conditions better. They are notably more tolerant to changes in temperature and salinity, and are not limited to a particular type of habitat. The only clear parameter indicated is the use of riparian habitats with a shallow depth of water. The results have also highlighted the strong association of the striped bass with the presence of white perch (*Morone americana*, moronidae family). This sympatric association between striped bass and white perch is also observed in New Brunswick rivers and on the U.S. east coast (Mansueti 1964; Thistle 2011[1]), and it suggests that both species colonize the same types of habitats or seek the same types of prey. Thus, a habitat colonized by white perch has also proved to be a habitat with high potential for striped bass.

The results obtained on the distribution of young-of-the-year striped bass in the St. Lawrence are not yet sufficient to define the specific characteristics of the habitat sought by juveniles for growth and feeding. The work currently underway should eventually provide enough information to determine the preferred habitat characteristics for larvae and young striped bass. The information currently available nevertheless helps to delineate an area with habitat potential for striped bass and young-of-the-year striped bass, i.e. the intertidal area of 0-5 metres between Lévis and Rivière-du-Loup on the south shore, and between Neuville and Petite-Rivière-Saint-François on the north shore, including the islands between these areas (Figure 10). However, additional studies are required to better define the areas of specific significance for these stages of development.

[1] Thistle, M.E. 2011. Presence and distribution of young-of-the-year striped bass (*Morone saxatilis*) throughout rivers and estuaries of the southern Gulf of St. Lawrence, summer 2011. Department of Fisheries and Oceans, 41 p.

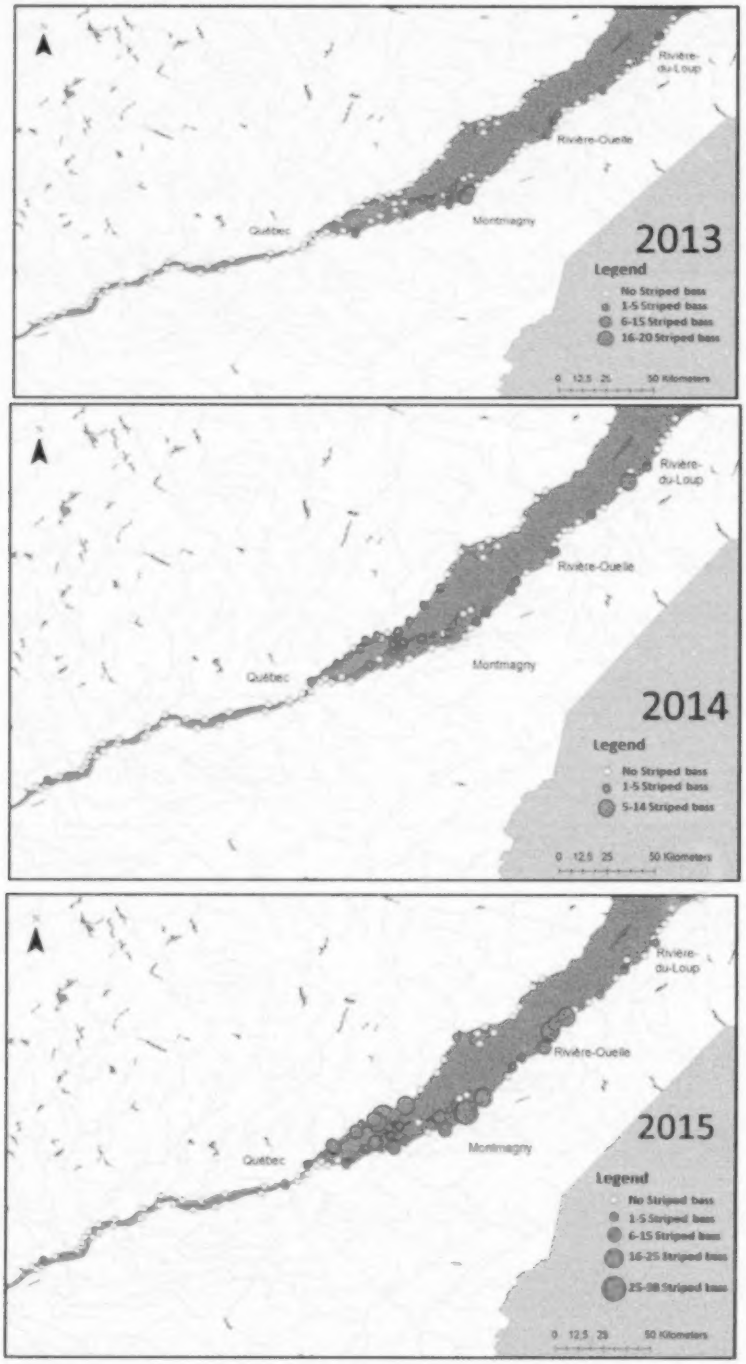


Figure 9. Catches from the annual recruitment monitoring network from 2013 to 2015.

Figure 10. Delineation of potential habitats for juvenile striped bass in the upper estuary of the St. Lawrence (from Pelletier et al. 2010)

Summary of the main functions, components and characteristics of habitats of importance for striped bass

The habitats identified as important for the striped bass are used for numerous functions, such as reproducing, rearing, feeding and migration. The components and characteristics associated with these functions are described in Table 1. The various threats to the habitat that support these functions were described in the 2011 Science Advisory Report (DFO 2011) and are also included in Table 1.

Table 1. Summary of the functions, components and characteristics of habitats of importance and associated threats.

Function (period)	Components	Characteristics	Threats to habitat
Reproduction (May-June)	• Rivière du Sud basin (spawning area confirmed in 2011) • Québec port area (potential spawning area) • Rivière Ouelle (presence of adult/mature females during the period suitable for reproduction)	• Water temperature between 13 and 18°C • Presence of an area of turbulence that promotes good oxygenation • Moderate current	• Disruption and destruction of habitat (including port development) • Dredging and discharging • Contamination
Growth of larvae and young-of-the-year (June to November)	• Anse Sainte-Anne (designated as critical habitat) • Potential area: intertidal area of 0-5 metres between Lévis and Rivière-du-Loup on the south shore, and between Neuville and Petite-Rivière-Saint-François on the north shore, including the islands between these areas.	• Depth at low tide between 0 and 5 m • Heterogeneous environment • High salinity gradient • Thermal front area • Unique circulation pattern that would help improve local turbidity and concentration of prey • Availability of sufficient quality and quantity of prey	• Dredging and discharging • Disruption and destruction of habitats • Contamination • Exploration, exploitation and transport of hydrocarbons
Feeding and migration of adults in connection with feeding (May to October)	• Concentration area located along the north shore of the upper estuary at Isle-aux-Coudres • Concentration area beginning upstream of Québec City, following the Chenal des Grands Voiliers south of Île d'Orléans, encompassing the area surrounding Isle-aux-Grues, and ending just downstream of Rivière-Ouelle. The Rivière Ouelle site maintains a high population throughout the open water period.		• Disruption and destruction of habitats • Contaminants
Wintering of adults (November to April)	• Québec area • South of Isle-aux-Grues • The Chenal des Grands Voiliers (winter movement route linking these two areas)		• Disruption and destruction of habitats • Contaminants

Sources of uncertainty

Various monitoring campaigns have helped delineate the range of the reintroduced striped bass population quite satisfactorily. However, the delineation of the range downstream, on the north shore east of the Saguenay River is currently inaccurate because no receivers have been installed there. There was very little monitoring upstream of Québec, which limits the information available in this part of the range.

Despite the apparent presence of distinct migration contingents in the striped bass population of the St. Lawrence River, rigorous analyses of the contingents will be needed to identify them properly and to determine their contribution to the recovery of the population. The presence of these contingents will also need to be taken into account in the critical habitat identification.

There is still uncertainty regarding the role of Rivière Ouelle in reproduction. Despite the fact that numerous adult striped bass have been found in this river during the season that is suitable for reproduction, the specific function performed by this habitat for striped bass is not yet known. The data collected in the Québec port area suggests that this is a spawning site. Additional studies to catch eggs or larvae should confirm this spawning site. Work should also be done to find new potential sites for spawning, especially in Rivière du Loup, where catches per unit of effort have been relatively high. With respect to the juveniles, additional studies will be required to better define the areas of particular importance for the early stages of development. Hydrodynamic studies in the areas frequented by young striped bass should help facilitate the identification of these crucial areas of importance.

Currently, there is little to no information on the habitat frequented by sub-adults (individuals 1 to 3 years of age) for the striped bass population of the St. Lawrence River. Efforts will need to be made in the coming years to fill this gap.

Since the efforts to reintroduce the striped bass are relatively recent, a follow-up will have to be done in the coming years to confirm whether the habitats currently being used by the population will persist.

There is no quantitative recovery target for the striped bass population of the St. Lawrence River so it is difficult to predict whether the habitats that have been identified so far are sufficient to support a recovered population.

CONCLUSION

Knowledge about the use of habitats in the St. Lawrence by various developmental stages of the striped bass has greatly increased over the last few years. A vast tracking network monitoring the movements of mature individuals helped identify winter aggregation areas and gathering areas during the reproduction period, learn more about summer activity and confirm other unsuspected concentration areas. Along with the direct field sampling work, this information has helped us to understand how the fish uses certain specific areas in the spring. The various networks for monitoring young-of-the-year track temporal changes in this segment of the population, which is vital to ensuring the recovery of the striped bass. Despite this, there is still significant work to be done in order to identify all striped bass critical habitats to ensure their maintenance, reproduction and survival.

SOURCES OF INFORMATION

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